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(71) Applicant *(for all designated States except US)*: **SHOWA DENKO K.K.** [JP/JP]; 13-9, Shiba Daimon 1-chome, Minato-ku, Tokyo 105-8518 (JP).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **WATANABE, Futoshi** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP). **KAWAMATA, Yasuji** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP). **HOSHINO, Ryoichi** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP). **OGASAWARA, Noboru** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP). **TAMURA, Takashi** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP). **HORIUCHI, Hirohumi** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP). **TERADA, Takashi** [JP/JP]; c/o Oyama Regional Office, Showa Denko K.K., 480, Inuzuka 1-chome, Oyama-shi, Tochigi 323-0811 (JP).

(74) Agents: **SHIMIZU, Hisayoshi** et al.; Idemitsu Nagahori Building, 4-26, Minamisemba 3-chome, Chuo-ku, Osaka-shi, Osaka 542-0081 (JP).

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(54) **Title:** HEADER FOR USE IN HEAT EXCHANGERS, HEAT EXCHANGER AND METHOD FOR MANUFACTURING THE SAME

(57) **Abstract:** A header for use in heat exchanger includes a base wall (20) with a plurality of tube insertion apertures (23), an opposite wall (30) opposed to the base wall (20), a pair of side walls (40a and 40b) disposed at both lateral sides of the base wall (20) and the opposite wall (30) and connecting the lateral sides and are inforcing walls (50a and 50b) disposed betwwen the base wall (20) and the opposite wall (30) along a longitudinal direction thereof and connecting the base wall (20) with the opposite wall (30). The side walls (40a and 40b) are integrally formed at both lateral sides of the base wall (20) by bending processing. A first half (30a) of the opposite wall (30) is integrally formed at a side of one of the side walls (40a) by bending processing, and a second half (30b) of the opposite wall (30) is integrally formed at a side of the other of the side walls (40b) by bending processing. Reinforcing walls (50a and 50b) are integrally formed at sides of the first half (30a) and the second half (30b) of the opposite wall (30) by bending processing. With this header for use in heat exchanger, high pressure resistance can be obtained, and the number of parts and the manufacturing cost can be decreased.

WO 02/079708 A2

DESCRIPTION

HEADER FOR USE IN HEAT EXCHANGERS, HEAT EXCHANGER AND METHOD FOR MANUFACTURING THE SAME

This application claims priority to Japanese Patent Application No. 2001-95242 filed on March 29, 2001 and U.S. Provisional Application No. 60/302,691 filed on July 5, 2001, the disclosure of which is incorporated by reference in its entirety.

Cross Reference to Related Applications

This application is an application filed under 35 U.S.C. § 111(a) claiming the benefit pursuant to 35 U.S.C. § 119(e)(1) of the filing date of Provisional Application No.60/302,691 filed on July 5, 2001 pursuant to 35 U.S.C. § 111(b).

Technical Field

The present invention relates to a header suitably used for a heat exchanger such as a condenser and an evaporator for use in a refrigeration system for an automobile air-conditioner, and also relates to a method for manufacturing the header.

Background Art

As a condenser for use in air-conditioning systems for automobiles, the so-called header-type heat exchanger, which is provided with a pair of headers and a plurality of heat exchanging

tubes disposed in parallel with each other between the headers with opposite ends thereof communicated with the headers, is widely used.

In this header-type heat exchanger, a pipe having a round cross-section is widely used as a header. However, in order to decrease the size and weight and enhance the performance, it is recently considered to employ a header having a flat cross-section such as an elliptical cross-section, an oval cross-section or a rectangular cross-section.

As for this kind of header, it is known to employ a header having a flat cross-section as disclosed by, for example, Japanese Unexamined Laid-open Patent Publication No.2000-39288. The schematic structure of this header is shown in Fig. 16. This header 1 includes two members, that is, a first peripheral wall member 2 and a second peripheral wall member 3. The first peripheral wall member 2 includes a base wall 2a in which a plurality of tube insertion apertures 2c are formed at predetermined intervals along the longitudinal direction of the base wall 2a and a pair of joining portions 2b and 2b provided at lateral sides of the base wall 2a. The second peripheral wall member 3 includes an opposite wall 3a to be opposed the base wall 2a and a pair of side walls 3b and 3b formed along the lateral sides of the opposite wall 3a.

The first peripheral wall member 2 and the second peripheral wall member 3 are coupled together, and the side walls 3b and 3b are joined to the joining portions 2b and 2b by pinching processing or brazing processing, thereby forming a header 1.

In the aforementioned header 1 for use in heat exchangers, a plurality of heat exchanging tubes 5 disposed in parallel with each other are inserted into corresponding tube insertion apertures 2c and fixed therein to thereby fabricate a header-type heat exchanger.

In the aforementioned header 1, however, the thickness of the peripheral wall member 2 and 3 becomes smaller in accordance with the request that the header be smaller in size and lighter in weight. Therefore, it is difficult to secure predetermined pressure resistance only by the peripheral wall members 2 and 3. To cope with the problems, it is considered to provide a reinforcing partition 4 in the header 1 as shown by the phantom line.

However, this header 1 having the aforementioned configuration cannot be manufactured by using an electric resistance weld pipe and therefore has to be manufactured by welding or pinching the wall members 2 and 3. This causes not only a complicated configuration but also an increased number of parts, resulting in complicated assembling operation and an increased manufacturing cost. Especially, in cases where the reinforcing partition 4 is assembled within the header 1, it is necessary to form a number of cut-out portions 4a in the partition 4 by machining processing or the like so as not to impede the insertion of the heat exchanging tube 5 into the header 1. This requires an adoption of troublesome machining processing and increases the number of processing steps, which in turn increases the manufacturing cost.

It is an object of the present invention to provide a header for use in heat exchangers capable of obtaining enough pressure resistance, decreasing the number of parts and the manufacturing cost and performing the assembly work easily.

It is another object of the present invention to provide a method for manufacturing the aforementioned header for use in heat exchangers.

It is still another object of the present invention to provide a heat exchanger using the aforementioned headers and a method for manufacturing the header and the heat exchanger.

Disclosure of Invention

According to the first aspect of the present invention, a header for use in heat exchangers includes a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall, an opposite wall opposed to the base wall, a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides, and a reinforcing wall disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall. The side walls are integrally formed at both lateral sides of the base wall by bending processing. A first half of the opposite wall constituting one half of the opposite wall is integrally formed at a side of one of the side walls by

bending processing. A second half of the opposite wall constituting the other half of the opposite wall is integrally formed at a side of the other of the side walls by bending processing. The reinforcing wall is integrally formed at at least one of sides of the first half of the opposite wall and the second half of the opposite wall by bending processing.

In the aforementioned header for use in heat exchangers, since the base wall, the side walls, the opposite wall and the reinforcing wall are integrally formed by bending processing, it is not required to perform joining processing of these members, such as brazing processing or pinching processing, and it becomes possible to reduce the number of parts. Furthermore, since the reinforcing wall is disposed between the base wall and the opposite wall, it is possible to assuredly obtain sufficient strength against the inner pressure.

It is preferable that the reinforcing wall is formed at each side of the first half of the opposite wall and the second half of the opposite wall. In this case, since there are two reinforcing walls, it becomes possible to further enhance the pressure resistance.

It is preferable that a side edge of the reinforcing wall opposed to the base wall is integrally brazed to the base wall.

It is preferable that the reinforcing wall is provided with tube engaging cut-out portions formed at positions corresponding to the plurality of tube insertion apertures, whereby each end of the plurality of heat exchanging tubes inserted into the tube

insertion apertures is engaged with the tube engaging cut-out portion in a positioned manner. In this case, since it is possible to position the heat exchanging tubes by engaging each end of the plurality of heat exchanging tubes with the tube engaging cut-out portion, the tube insertion amount adjustment can be performed more easily and accurately, and the tube insertion operation can be performed smoothly.

Furthermore, it is preferable that the reinforcing wall is provided with insertion ledges at the side edge thereof opposed to the base wall, and the base wall is provided with insertion ledge engaging apertures at positions corresponding to the insertion ledges, and the insertion ledges are inserted into the insertion ledge engaging apertures and engaged therewith. In this case, since the insertion ledges of the reinforcing wall are engaged with and fixed to the insertion ledge engaging apertures, it becomes possible to avoid problems such as springback. Thus, the provisional assembly can be maintained stably after the bending processing until the brazing processing, which enables to maintain the high dimensional accuracy.

It is preferable that the insertion ledges are integrally brazed to the base wall with the insertion ledges inserted into the insertion ledge engaging apertures.

It is preferable that a peripheral edge of the tube insertion aperture is inwardly bent. In this case, the heat exchanging tube is guided smoothly by the peripheral edge of the tube insertion

aperture at the time of inserting the tube into the tube insertion aperture. Therefore, the tube insertion operation can be performed more easily. Furthermore, the joining area between the tube and the tube insertion aperture can be kept larger, which in turn enables to obtain reliable air-tightness of the joined portion.

According to a second aspect of the present invention, a header for use in heat exchangers, the header comprises:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall;

an opposite wall opposed to the base wall;

a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides; and

a reinforcing wall disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall,

wherein the side walls are integrally formed at both lateral sides of the base wall by bending processing,

wherein a first half of the opposite wall constituting one half of the opposite wall is integrally formed at a side of one of the side walls by bending processing,

wherein a second half of the opposite wall constituting the other half of the opposite wall is integrally formed at a side of the other of the side walls by bending processing, and

wherein the reinforcing wall is integrally formed at respective sides of the first half of the opposite wall and the second half of the opposite wall by bending processing,

wherein insertion ledges are formed at certain intervals in a longitudinal direction of the header at edges of the reinforcing walls opposed to the base wall,

wherein the insertion ledges of the one of the reinforcing walls and the insertion ledges of the other of the reinforcing walls are disposed alternatively along the longitudinal direction of the header,

wherein the base wall is provided with insertion ledge engaging apertures at positions corresponding to the insertion ledges, and

wherein the insertion ledges are inserted into corresponding insertion ledge engaging apertures and engaged therewith.

It is preferable that the insertion ledge engaging apertures are formed along the longitudinal direction of the header in a zigzag manner.

It is preferable that a tip portion of the insertion ledge is inserted into the insertion ledge engaging aperture, and the tip portion of the insertion ledge is bent and engaged with an external surface of the base wall.

It is preferable that the bent portion is formed by bending the tip portion of the insertion ledge by caulking processing.

The aforementioned header for use in heat exchangers can be

manufactured by the following method.

That is, according to the third aspect of the present invention, in a method for manufacturing a header for use in heat exchangers in which the header includes a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall, an opposite wall opposed to the base wall, a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides, and a reinforcing wall disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall, the method comprises:

a step for preparing a formed plate, the formed plate including a base wall region having the plurality of tube insertion apertures and extending in a longitudinal direction of the formed plate, a pair of side wall regions formed at both lateral sides of the base wall region and extending in the longitudinal direction, a first half region of an opposite wall formed at one of lateral sides of the base wall region and extending in the longitudinal direction, a second half region of an opposite wall formed at the other of lateral sides of the base wall region and extending in the longitudinal direction, and a reinforcing wall region formed at at least one of the first and second half regions of the opposite wall and extending in the longitudinal direction;

a step for bending the reinforcing wall region relative to

the first half region of the opposite wall and/or the second half region of the opposite wall;

a step for bending the first half region of the opposite wall and/or the second half region of the opposite wall relative to the side wall regions; and

a step for bending the side wall regions relative to the base wall region, to thereby obtain the header in which the base wall, the side walls, the opposite wall and the reinforcing wall are constituted by the base wall region, the side wall regions, the opposite wall region and the reinforcing wall region, respectively.

According to the third aspect of the present invention, it is preferable that in the step for preparing the formed plate the reinforcing wall region is formed at each side of the first half region and the second half region of the opposite wall.

In the step for preparing the formed plate, it is preferable that the tube engaging cut-out portions are formed at portions of the reinforcing wall corresponding to the plurality of tube insertion apertures such that ends of the heat exchanging tubes inserted in the tube insertion apertures are engaged with the engaging cut-out portions in a positioned manner.

It is preferable that, in the step for preparing the formed plate, insertion ledges are formed at a base wall side edge of the reinforcing wall and insertion ledge engaging apertures are formed at positions of the base wall corresponding to the insertion ledges, further comprising a step of inserting the insertion ledges into

the insertion ledge engaging apertures.

Furthermore, it is preferable that, in the step for preparing the formed plate, the formed plate is formed by die-cutting and pressing a brazing sheet with a brazing layer clad on at least one surface thereof.

The fourth aspect of the present invention specifies the heat exchanger using the header according to the first aspect of the present invention.

According to the fourth aspect of the present invention, a heat exchanger, comprises:

a pair of headers for use in heat exchangers; and

a plurality of heat exchanging tubes disposed in parallel with each other between the pair of headers with opposite ends thereof communicated with the headers,

wherein at least one of the pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting the heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall;

an opposite wall opposed to the base wall;

a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides; and

a reinforcing wall disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall,

wherein the side walls are integrally formed at both lateral sides of the base wall by bending processing,

wherein a first half of the opposite wall constituting one half of the opposite wall is integrally formed at a side of one of the side walls by bending processing,

wherein a second half of the opposite wall constituting the other half of the opposite wall is integrally formed at a side of the other of the side walls by bending processing, and

wherein the reinforcing wall is integrally formed at at least one of sides of the first half of the opposite wall and the second half of the opposite wall by bending processing.

In the hear exchanger, the same functions and effects as mentioned above can be obtained since the heat exchanger uses the headers according to the first aspect of the present invention.

In the heat exchanger according to the fourth aspect of the present invention, it is preferable that the reinforcing wall is provided with tube engaging cut-out portions formed at positions corresponding to the plurality of tube insertion apertures, whereby each end of the plurality of heat exchanging tubes inserted into the tube insertion apertures is engaged with the tube engaging cut-out portion in a positioned manner.

Furthermore, it is preferable that each end of the plurality of heat exchanging tubes is brazed to the header.

The fifth aspect of the present invention specifies the heat exchanger using the headers according to the second aspect of the

present invention.

According to the fifth aspect of the present invention, a heat exchanger, comprises:

a pair of headers for use in heat exchangers; and

a plurality of heat exchanging tubes disposed in parallel with each other between the pair of headers with opposite ends thereof communicated with the headers,

wherein at least one of the pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting the heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall;

an opposite wall opposed to the base wall;

a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides; and

reinforcing walls disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall,

wherein the side walls are integrally formed at both lateral sides of the base wall by bending processing,

wherein a first half of the opposite wall constituting one half of the opposite wall is integrally formed at a side of one of the side walls by bending processing,

wherein a second half of the opposite wall constituting the other half of the opposite wall is integrally formed at a side of

the other of the side walls by bending processing,

wherein each of the reinforcing walls is integrally formed at each of sides of the first half of the opposite wall and the second half of the opposite wall by bending processing,

wherein each of the reinforcing walls is provided with insertion ledges at a base wall side edge of the reinforcing wall opposed to the base wall at predetermined intervals in a longitudinal direction of the header,

wherein the insertion ledges of one of the reinforcing walls and the insertion ledges of the other of the reinforcing walls are disposed alternatively in the longitudinal direction of the header,

wherein the base wall is provided with insertion ledge engaging apertures at positions corresponding to the insertion ledges, and

wherein the insertion ledges are inserted into the insertion ledge engaging apertures and engaged therewith, respectively.

In this heat exchanger, since the heat exchanger uses the headers according to the second aspect of the present invention, the same functions and effects as mentioned above can be obtained.

In the fifth aspect of the present invention, it is preferable that the reinforcing wall is provided with tube engaging cut-out portions formed at positions corresponding to the plurality of tube insertion apertures, whereby each end of the plurality of heat exchanging tubes inserted into the tube insertion apertures is engaged with the tube engaging cut-out portion in a positioned

manner.

Furthermore, it is preferable that the each end of the plurality of heat exchanging tubes is brazed to the header.

Furthermore, it is preferable that the insertion ledge engaging apertures are formed in a zigzag manner in the longitudinal direction of the header.

The sixth aspect of the present invention specifies the manufacturing method of the heat exchanger using the headers according to the first aspect of the present invention.

According to the sixth aspect of the present invention, a manufacturing method of a heat exchanger, the method comprises:

a step for preparing a pair of headers for use in heat exchangers;

a step for preparing a plurality of heat exchanging tubes; and

a step for disposing the plurality of heat exchanging tubes in parallel with each other between the pair of headers with opposite ends thereof communicated with the headers,

wherein at least one of the pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall;

an opposite wall opposed to the base wall;

a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides;

and

a reinforcing wall disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall,

wherein the side walls are integrally formed at both lateral sides of the base wall by bending processing,

wherein a first half of the opposite wall constituting one half of the opposite wall is integrally formed at a side of one of the side walls by bending processing,

wherein a second half of the opposite wall constituting the other half of the opposite wall is integrally formed at a side of the other of the side walls by bending processing, and

wherein the reinforcing wall is integrally formed at at least one of sides of the first half of the opposite wall and the second half of the opposite wall by bending processing.

In this manufacturing method of the heat exchanger, since it uses the headers according to the first aspect of the present invention, the same functions and effects as mentioned above can be obtained.

According to the sixth aspect of the present invention, the step for preparing the header comprises:

a step for preparing a formed plate, the formed plate including a base wall region having the plurality of tube insertion apertures and extending in a longitudinal direction of the formed plate, a pair of side wall regions formed at both lateral sides

of the base wall region and extending in the longitudinal direction, a first half region of an opposite wall formed at one of lateral sides of the base wall 1 region and extending in the longitudinal direction, a second half region of an opposite wall formed at the other of lateral sides of the base wall region and extending in the longitudinal direction, and a reinforcing wall region formed at at least one of the first half and second half regions of the opposite wall and extending in the longitudinal direction;

a step for bending the reinforcing wall region relative to the first half region of the opposite wall and/or the second half region of the opposite wall;

a step for bending the first half region of the opposite wall and/or the second half region of the opposite wall relative to the side wall regions; and

a step for bending the side wall regions relative to the base wall region.

Furthermore, it is preferable that the each end of the plurality of heat exchanging tubes is brazed to the header.

According to the seventh aspect of the present invention, a manufacturing method of a heat exchanger, comprises:

a step for preparing a pair of headers for use in heat exchangers;

a step for preparing a plurality of heat exchanging tubes; and

a step for disposing the plurality of heat exchanging tubes

in parallel with each other between the pair of headers with opposite ends thereof communicated with the headers,

wherein at least one of the pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of the base wall;

an opposite wall opposed to the base wall;

a pair of side walls disposed at both lateral sides of the base wall and the opposite wall and connecting the lateral sides; and

reinforcing walls disposed between the base wall and the opposite wall along a longitudinal direction thereof and connecting the base wall to the opposite wall,

wherein the side walls are integrally formed at both lateral sides of the base wall by bending processing,

wherein a first half of the opposite wall constituting one half of the opposite wall is integrally formed at a side of one of the side walls by bending processing,

wherein a second half of the opposite wall constituting the other half of the opposite wall is integrally formed at a side of the other of the side walls by bending processing,

wherein each of the reinforcing walls is integrally formed at each of sides of the first half of the opposite wall and the second half of the opposite wall by bending processing,

wherein each of the reinforcing walls is provided with

insertion ledges at a base wall side edge of the reinforcing wall opposed to the base wall at predetermined intervals in a longitudinal direction of the header,

wherein the insertion ledges of one of the reinforcing walls and the insertion ledges of the other of the reinforcing walls are disposed alternatively in the longitudinal direction of the header,

wherein the base wall is provided with insertion ledge engaging apertures at positions corresponding to the insertion ledges, and

wherein the insertion ledges are inserted into the insertion ledge engaging apertures and engaged therewith, respectively.

In this manufacturing method of the heat exchanger, since it uses the headers according to the second aspect of the present invention, the same functions and effects as mentioned above can be obtained.

In this manufacturing method according to the seventh aspect of the present invention, the step for preparing the pair of header comprises:

a step for preparing a formed plate, the formed plate including a base wall region having the plurality of tube insertion apertures and extending in a longitudinal direction of the formed plate, a pair of side wall regions formed at both lateral sides of the base wall region and extending in the longitudinal direction, a first half region of an opposite wall formed at one of lateral sides of the base wall 1 region and extending in the longitudinal

direction, a second half region of an opposite wall formed at the other of lateral sides of the base wall region and extending in the longitudinal direction, and a reinforcing wall region formed at at least one of the first half and second half regions of the opposite wall and extending in the longitudinal direction;

a step for bending the reinforcing wall region relative to the first half region of the opposite wall and/or the second half region of the opposite wall;

a step for bending the first half region of the opposite wall and/or the second half region of the opposite wall relative to the side wall regions; and

a step for bending the side wall regions relative to the base wall region.

Furthermore, it is preferable that each end of the plurality of heat exchanging tubes is brazed to the header.

Other objects and advantages of the present invention will be apparent from the following preferred embodiments.

Brief Description of Drawings

Fig. 1 is an exploded perspective view showing a header and therearound applied to a heat exchanger according to a first embodiment of the present invention.

Fig. 2A is a front view of the header for use in heat exchangers, and Fig. 2B is a side view thereof.

Fig. 3 is a cross-sectional view of the header for use in heat

exchangers.

Fig. 4 is an enlarged side cross-sectional view showing the tube insertion aperture of the header and therearound.

Fig. 5 is a cross-sectional view taken along the line 5-5 in Fig. 3.

Fig. 6A is a cross-sectional view taken along the line 6-6 in Fig. 3, and Fig. 6B is an enlarged cross-sectional view of the portion surrounded by the alternate long and short dash line in Fig. 6A.

Fig. 7 is a perspective view showing a press formed plate for manufacturing the header of the embodiment.

Fig. 8 is a plane view showing the press formed plate.

Fig. 9 is a side view showing a header and therearound applied to a heat exchanger according to a second embodiment of the present invention.

Fig. 10 is a cross-sectional view showing the header for use in heat exchangers according to the second embodiment.

Fig. 11A is a cross-sectional view taken along the line 11-11 in Fig. 10, and Fig. 11B is an enlarged cross-sectional view of the portion surrounded by the alternate long and short dash line in Fig. 11A.

Fig. 12 is a perspective view showing a press formed plate for manufacturing the header of the second embodiment.

Fig. 13 is a plane view showing the press formed plate of the second embodiment.

Figs. 14A to 14E are enlarged cross-sectional views showing the connecting portion of the reinforcing wall and the base wall of the header for use in heat exchangers and therearound according to a modification of the present invention.

Figs. 15A and 15B are enlarged cross-sectional views showing the connecting portion of the reinforcing wall and the base wall of the header for use in heat exchangers and therearound according to another modification of the present invention.

Fig. 16 is an exploded perspective view showing a conventional rectangular header for heat exchangers and therearound.

Best Mode for Carrying Out the Invention

<First embodiment>

Figs. 1 to 6 show a header 10 for use in heat exchangers according to a first embodiment of the present invention. As shown in these figures, the header 10 includes a belt-shaped base wall 20, an opposite wall 30 to be opposed to the base wall 20, a pair of side walls 40a and 40b disposed between the lateral sides of the base wall 20 and the opposite wall 30 and a pair of reinforcing walls 50a and 50b disposed between the base wall 20 and the opposite wall 30 at the widthwise central position thereof and extending in the longitudinal direction of the header 10.

As shown in Figs. 7 and 8, this header 10 is an integrally formed article obtained by bending a press formed plate 11 having a predetermined shape formed by die-cut press forming. In detail,

the press formed plate 11 is a wide belt-shaped plate. The plate 11 has a base wall region 21 extending in the longitudinal direction of the plate 11 at the widthwise-middle region of the plate 11. The base wall region 21 will constitute the aforementioned base wall 20. At both sides of the base wall region 21, side wall regions 41a and 41b extending in the longitudinal direction are integrally provided. These side wall regions 41a and 41b will constitute the aforementioned side walls 40a and 40b. Furthermore, at the side of one of the side wall regions 41a, a first half opposite wall region 31a extending in the longitudinal direction is integrally provided. This first half opposite wall region 31a will constitute a first half 30a of the aforementioned opposite wall 30. At the side of the other side wall region 41b, a second half opposite wall region 31b extending in the longitudinal direction is integrally provided. This second half opposite wall region 31b will constitute a second half 30b of the aforementioned opposite wall 30. Furthermore, at the sides of the first half opposite wall region 31a and the second half opposite wall region 31b, reinforcing wall regions 51a and 51b extending in the longitudinal direction are integrally provided. These reinforcing wall regions 51a and 51b will constitute the aforementioned reinforcing walls 50a and 50b.

In Fig. 8, the boundary line (bending line) of each region is shown by a broken line for an easy understanding of the invention.

At the base wall region 21 of the press formed plate 11, tube insertion apertures 23 each extending the widthwise direction of

the base wall region 21 are provided at certain intervals in the longitudinal direction of the base wall region 21. The peripheral portion 23a of the tube insertion aperture 23 is curved inwardly, i.e., toward the inside of the header to be formed by burring processing. Furthermore, along the centerline of the base wall region 21, a plurality of square-shaped insertion ledge engaging apertures 25 are formed at certain intervals so as to be located between the adjacent tube insertion apertures 23.

Furthermore, at positions of the side edge of the reinforcing wall region 51a and 51b corresponding to the aforementioned tube insertion apertures 23, a plurality of tube engaging cut-out portions 53a and 53b are formed at predetermined intervals in the longitudinal direction of the reinforcing wall region 51a and 51b. Furthermore, at the side edge of the reinforcing wall region 51a and 51b between the adjacent tube engaging cut-out portions 53a and 53b, a plurality of rectangular-shaped insertion ledges 55a and 55b corresponding to the aforementioned tube insertion ledge engaging apertures 25 are formed at predetermined intervals in the longitudinal direction of the plate 11.

In this embodiment, bending processing are conducted to this press formed plate 11 along the broken lines (bending lines) shown in Fig. 8 to thereby obtain the aforementioned header 10. In detail, the reinforcing wall regions 51a and 51b are bent inwardly by 90° relative to the first half opposite wall region 31a and the second half opposite wall region 31b, and the first half opposite wall

region 31a and the second half opposite wall region 31b are bent inwardly by 90° relative to the side wall regions 41a and 41b. Then, both the side wall regions 41a and 41b are bent by 90° relative to the base wall region 21 to thereby fit the reinforcing wall regions 51a and 51b. Thus, the fitted insertion ledges 55a and 55b of the reinforcing wall regions 51a and 51b are inserted into the insertion ledge engaging apertures 25 of the base wall region 20, respectively, to thereby engage therewith.

In this invention, the order of bending processing is not limited to the aforementioned embodiment, and may be changed arbitrarily.

Through the aforementioned bending processing, as shown in Figs. 1 to 6, the header 10 for use in heat exchangers is manufactured. In this header 10, the side wall regions 41a and 41b constitute the side walls 40a and 40b, the first half opposite wall region 31a constitutes one half 30a of the opposite wall 30, the second half opposite wall region 31b constitutes the other half 30b of the opposite wall 30, and the reinforcing wall regions 51a and 51b constitute the reinforcing walls 50a and 50b.

In this assembled state, the tube engaging cut-out portions 53a and 53b of the reinforcing walls 50a and 50b are disposed so as to face the corresponding tube insertion apertures 23 of the base wall 20.

Furthermore, as shown in Fig. 5, both the side edges of the tube insertion aperture 23 formed in the base wall 20 are bent

outwardly in accordance with the aforementioned bending processing to constitute tube insertion guides 23b.

In manufacturing a heat exchanger using the aforementioned header 10, as shown in Fig. 1, end portions of a plurality of heat exchanging tubes 60 disposed in parallel with each other via a corrugated fin 70 are inserted into the corresponding tube insertion apertures 23 of the header 10 to engage with the tube engaging cut-out portions 53a and 53b of the reinforcing walls 50a and 50b formed in the header 10 in a positioned manner.

At this time, since the tube insertion guides 23b and 23b are formed at both the edges of the tube insertion aperture 23 formed in the header 10 as described above (see Fig. 5), the tube end portion will be guided smoothly into the tube insertion aperture 23 by the guides 23b and 23b. Accordingly, the insertion of the heat exchanging tube 60 into the tube insertion aperture 23 can be performed easily. Furthermore, since the positioning of the tube 60 is completed by engaging the tube end with the tube engaging cut-out portions 53a and 53b, the insertion amount of the tube 60 and the like can be performed automatically, which enables an easy insertion of the tube 60.

In this way, a heat exchanger, which is provided with a pair of headers 10, a plurality of heat exchanging tubes 60 disposed in parallel with each other with opposite ends thereof communicated with the headers 10 and 10 and corrugated fins 70 interposed between the adjacent heat exchanging tubes 60, can be obtained.

In this embodiment, the press formed plate 11 constituting the header 10 and the heat exchanging tube 60 is made of a brazing sheet in which a brazing layer is clad on at least one surface of a bare member or a plate with a brazing layer in which brazing materials such as powder brazing materials are given to at least one surface of a bare member. Then, as described above, a provisionally assembled heat exchanger is obtained by alternatively stacking the heat exchanging tubes 60 and the corrugated fins 70 between the pair of headers 10. Then, the provisionally assembled heat exchanger is brazed in a furnace, thereby obtaining a heat exchanger.

As mentioned above, according to this header 10 for use in heat exchangers, since the header 10 is obtained by bending a press formed plate 11, the header 10 can be manufactured efficiently only by performing a series of bending press working.

Furthermore, since the header 10 of this embodiment is manufactured by using only one sheet of the press formed plate 11, it is not necessary to perform troublesome joining processing such as brazing processing and/or pinching processing. This results in a decreased number of parts, simplified assembling operation and a reduced manufacturing cost.

Furthermore, in the header 10 of this embodiment, since the reinforcing walls 50a and 50b are disposed between the base wall 20 and the opposite wall 30, sufficient strength against inner pressure can be obtained. Accordingly, the header 10 can be applied

to a refrigeration cycle using CO_2 refrigerant in which high pressure resistance is required strictly.

Furthermore, since the tube engaging cut-out portions 53a and 53b of the reinforcing walls 50a and 50b can be formed by the die-cut press forming at the time of obtaining the press formed plate 11, it is not necessary to perform troublesome work such as machining work for forming the cut-out portions, resulting in easier manufacturing of the header.

Furthermore, in this embodiment, the insertion ledges 55a and 55b are formed at the side edges of the reinforcing wall regions 51a and 51b of the press formed plate 11 and the insertion ledge engaging apertures 25 are formed in the base wall region 21, and then the insertion ledge 55a and 55b are inserted in the insertion ledge engaging apertures 25 in a positioned manner at the time of bending processing of the press formed plate 11. Accordingly, faults such as springback due to the bending of the plate can be prevented, thereby stabilizing the configuration of the provisionally assembled article. Thus, the stabilized configuration of the assembled article can be maintained until the brazing processing after the completion of the bending processing, resulting in enhanced dimensional accuracy and high quality.

Furthermore, in this embodiment, as shown in Figs. 3 and 4, since the peripheral portion 23a of the tube insertion aperture 23 of the header 10 is curved inwardly by burring processing, the tube 60 can be guided smoothly at the time of inserting the tube

60 into the aperture 23. Thus, the tube insertion can be performed easily. In addition, the inwardly curved peripheral portion 23a of the tube insertion aperture 23 increases the joining area between the peripheral portion 23a and the tube 60, resulting in enhanced air-tightness therebetween, which in turn further enhances quality and reliability of the header.

<Second embodiment>

Figs. 9 to 13 show a header 10 for use in heat exchangers according to a second embodiment of the present invention. As shown in these figures, in the same manner as in the first embodiment, the press formed plate 11 constituting the header 10 is provided with a base wall region 21, side wall regions 41a and 41b, a first half opposite wall region 31a, a second half opposite wall region 31b and first and second reinforcing wall regions 51a and 51b. At the base wall region 21, tube insertion apertures 23 are provided at certain intervals.

Furthermore, in the press formed plate 11, at the side edges of the first and second reinforcing wall regions 51a and 51b, insertion ledges 55a and 55b are formed alternatively in the longitudinal direction of the plate 11. Furthermore, between the adjacent tube insertion apertures 23 in the base wall region 21, a first insertion ledge engaging aperture 25a and a second insertion ledge engaging aperture 25b corresponding to the insertion ledges 55a and 55b are formed alternatively in a zigzag manner.

Each region 31a, 31b, 41a, 41b, 51a and 51b of this press formed

plate 11 is bent, so that the reinforcing regions 51a and 51b are put together. In this state, the insertion ledges 55a and 55b of the reinforcing regions 51a and 51b are inserted into corresponding insertion ledge engaging apertures 25a and 25b. Furthermore, the tip portions of the insertion ledges 55a and 55b are bent outwardly by caulking processing, whereby the bent portions 80a and 80b are engaged with the external surface of the base wall 20. Thus, the header 10 for use in heat exchangers is manufactured.

Since the other structures are the same as those of the first embodiment, the explanation will be omitted by allotting the same reference numeral to the same or corresponding portion.

In the header 10 for use in heat exchangers according to the second embodiment, effects similar to those of the first embodiment can be obtained.

Furthermore, in the header 10 for use in heat exchangers according to the second embodiment, the insertion ledges 55a and 55b formed at the side edges of the reinforcing regions 51a and 51b of the press formed plate 11 are formed alternatively along the longitudinal direction of the header between the first reinforcing region 51a and the second reinforcing region 51b, and that the insertion ledge engaging apertures 25a and 25b are formed in a zigzag manner corresponding to the insertion ledges 55a and 55b. Accordingly, at the time of bending the first reinforcing wall region 51a and the second reinforcing wall region 51b, it is prevented that the insertion ledges 55a and 55b interfere each other.

Accordingly, the insertion operations of the insertion ledges 55a and 55b into the engaging apertures 25a and 25b can be performed smoothly, which makes it easier to manufacture the header 10.

Furthermore, in the second embodiment, since the tip portions of the insertion ledges 55a and 55b are bent outwardly by caulking processing so that the bent portions 80a and 80b are engaged with the external surface of the base wall 20, stronger engaging status can be obtained and the number of insertion ledges 55a and 55b can be decreased, resulting in decreased amount of materials. Accordingly, the manufacturing cost can be decreased. Furthermore, since the tip portion of the insertion ledge is caulked and fixed, faults such as spring back due to a bending process can be prevented more assuredly, thereby stabilizing the configuration. Accordingly, the dimensional accuracy can be further improved, and therefore header products with higher quality can be obtained.

In cases where the structure in which the tip portions of the insertion ledges 55a and 55b are caulked and engaged with the external surface of the base wall 20 is applied to the first embodiment, effects similar to those of the second embodiment can be obtained.

Now, in the aforementioned embodiments, as shown in Figs. 6B and 11B, the tip portions of the reinforcing walls 50a and 50b are inserted into and engaged with the base wall 20. However, the present invention is not limited to the above.

For example, as shown in Fig. 14A, the tip ends of the

reinforcing walls 50a and 50b may be brazed to the inner surface of the base wall 20 with the tip ends abutted thereto.

Furthermore, as shown in Fig. 14B, the outwardly bent tip portions of the reinforcing walls 50a and 50b may be brazed to the inner surface of the base wall 20. In this case, the larger joining area between the reinforcing walls 50a and 50b and the base wall 20 can be secured, which assuredly prevents generation of faults such as poor brazing.

Furthermore, in the present invention, two tip portions of the reinforcing walls 50a and 50b may be secured to the base wall 20 by another methods other than the aforementioned methods.

For example, as shown in Fig. 14C, the reinforcing walls 50a and 50b may be brazed to the base wall 20 in the state in which the tip end of the first reinforcing wall 50a abuts against the inner surface of the base wall 20 while the insertion ledge 55b of the second reinforcing wall 50b is inserted into the base wall 20.

Furthermore, as shown in Fig. 14D, the reinforcing walls 50a and 50b may be brazed to the base wall 20 in the state in which the tip end of the first reinforcing wall 50a abuts against the inner surface of the base wall 20 while the bent tip portion 81b of the second reinforcing wall 50b abuts against the base wall 20.

Furthermore, as shown in Fig. 14E, the reinforcing walls 50a and 50b may be brazed to the base wall 20 in the state in which the bent tip portion 81a of the first reinforcing wall 50a abuts

against the inner surface of the base wall 20 while the insertion ledge 55b of the second reinforcing wall 50b abuts against the base wall 20.

Furthermore, in the present invention, it is not required that the tip portion of the reinforcing walls 50a and 50b continuously extend along the longitudinal direction of the reinforcing walls.

For example, as shown in Fig. 15A, the reinforcing walls 50a and 50b may be brazed to the base wall 20 in the state in which the bent tip portions 81a and 81b formed at certain intervals along the longitudinal direction of the reinforcing walls 50a and 50b abut against the base wall 20 while the end portions between the bent tip portions abut against the base wall 20.

Alternatively, as shown in Fig. 15B, the reinforcing walls 50a and 50b may be brazed to the base wall 20 in the state in which the bent tip portions 81a and 81b formed at certain intervals along the longitudinal direction of the reinforcing walls 50a and 50b abut against the base wall 20 while the end portions 55b between the bent tip portions are inserted into the base wall 20.

Furthermore, in the present invention, it is possible to arbitrarily combine the aforementioned tip securing methods of reinforcing walls 50a and 50b, that is, the inserting method, the inserting and caulking method, the abutting method and the bending and securing method.

In the aforementioned embodiment, two reinforcing walls 50a and 50b are provided. However, the present invention is not limited

to it. For example, a reinforcing wall region may be provided at either the first half opposite wall region 31a or the second half opposite wall region 31b. In other words, one of the aforementioned reinforcing walls 50a and 50b may be omitted.

As mentioned above, in the header for use in heat exchangers according to the present invention, since the base wall, the side walls, the opposite wall and the reinforcing wall are integrally formed by bending processing, it is not necessary to perform troublesome joining processing such as brazing processing or pinching processing. Furthermore, it is possible to decrease the number of parts. Accordingly, the assembly operation can be performed easily and the manufacturing costs can be decreased. Furthermore, since the reinforcing wall is disposed between the base wall and the opposite wall, enough pressure resistance can be obtained assuredly.

In cases where two reinforcing walls are provided, it is possible to further enhance the pressure resistance.

Furthermore, in cases where the tube engaging cut-out portion is provided in the reinforcing wall, the positioning of the tube can be performed by engaging the end portion of the tube with the cut-out portion. As a result, there is an advantage that the insertion of the tube can be performed smoothly and the assembly operation can be performed easily.

Furthermore, in cases where the insertion ledge formed in the reinforcing wall is inserted into and fixed thereto the insertion

ledge engaging aperture of the base wall, faults such as springback due to bending processing can be prevented and the configuration of the provisionally assembled article can be stabilized. Accordingly, the dimensional accuracy can be improved and the quality can be enhanced.

Furthermore, in cases where the insertion ledge formed at the reinforcing wall is inserted into the insertion ledge engaging aperture and the inserted tip portion is bent by caulking processing to thereby engage with the external surface of the base wall, the reinforcing wall can be fixed to the base wall more assuredly. Thus, faults such as springback can be prevented assuredly, and the configuration of the provisional header can be stabilized. Accordingly, there is advantage that higher quality can be obtained.

Furthermore, in cases where the tip portion of the reinforcing wall is bent and secured to the inner surface of the base wall, the joining area of the reinforcing wall to the base plate can be increased. Accordingly, it becomes possible to more assuredly prevent securing faults such as brazing faults.

Furthermore, in cases where the peripheral portion of the tube insertion aperture is curved inwardly, at the time of inserting the tube into the tube insertion aperture, the peripheral portion guides the tube. Therefore, the tube can be inserted easily. Furthermore, larger joining area between the tube and the peripheral portion of the tube insertion aperture can be obtained, resulting in enhanced air-tightness therebetween, which in turn enhances the

quality and reliability.

On the other hand, according to the method for manufacturing the header according to the present invention, the same effects as mentioned above can be obtained since the method specifies one of the manufacturing processes of the aforementioned header.

Furthermore, according to the heat exchanger according to the present invention, the same effects as mentioned above can be obtained since the heat exchanger uses the aforementioned headers for use in heat exchangers.

Furthermore, according to the method for manufacturing the header according to the present invention, the same effects as mentioned above can be obtained since the method uses the aforementioned headers for use in heat exchangers.

The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intent, in the use of such terms and expressions, of excluding any of the equivalents of the features shown and described or portions thereof, but it is recognized that various modifications are possible within the scope of the invention claimed.

Industrial Applicability

The header can be suitably used for a heat exchanger such as a condenser and an evaporator for use in a refrigeration system for an automobile air-conditioner.

CLAIMS

1. A header for use in heat exchangers, said header comprising:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall;

an opposite wall opposed to said base wall;

a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides; and

a reinforcing wall disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting said base wall to said opposite wall,

wherein said side walls are integrally formed at both lateral sides of said base wall by bending processing,

wherein a first half of said opposite wall constituting one half of said opposite wall is integrally formed at a side of one of said side walls by bending processing,

wherein a second half of said opposite wall constituting the other half of said opposite wall is integrally formed at a side of the other of said side walls by bending processing, and

wherein said reinforcing wall is integrally formed at at least one of sides of said first half of said opposite wall and said second half of said opposite wall by bending processing.

2. The header for use in heat exchangers as recited in claim 1, wherein said reinforcing wall is integrally formed at each of said sides of said first half of said opposite wall and said second half of said opposite wall.

3. The header for use in heat exchangers as recited in claim 1 or 2, wherein a side edge of said reinforcing wall opposed to said base wall is integrally brazed to said base wall.

4. The header for use in heat exchangers as recited in claim 2, wherein said reinforcing walls are fitted with each other and integrally brazed with each other.

5. The header for use in heat exchangers as recited in any one of claims 1 to 4, wherein said reinforcing wall is provided with tube engaging cut-out portions formed at positions corresponding to said plurality of tube insertion apertures, whereby each end of said plurality of heat exchanging tubes inserted into said tube insertion apertures is engaged with said tube engaging cut-out portion in a positioned manner.

6. The header for use in heat exchangers as recited in any one of claims 1 to 5, wherein said reinforcing wall is provided with insertion ledges at a base wall side edge of said reinforcing wall opposed to said base wall, wherein said base wall is provided

with insertion ledge engaging apertures at positions corresponding to said insertion ledges, and wherein said insertion ledges are inserted into said insertion ledge engaging apertures and engaged therewith, respectively.

7. The header for use in heat exchangers as recited in claim 6, wherein said insertion ledges are integrally brazed to said base wall with said insertion ledges inserted into said insertion ledge engaging apertures.

8. The header for use in heat exchangers as recited in claim 6 or 7, wherein said insertion ledges are intermittently formed at certain intervals in the longitudinal direction of said header.

9. The header for use in heat exchangers as recited in any one of claims 6 to 8, wherein a tip portion of said insertion ledge is inserted into said insertion ledge engaging aperture, and wherein said tip portion of said insertion ledge is bent and engaged with an external surface of said base wall.

10. The header for use in heat exchangers as recited in any one of claims 1 to 9, wherein a peripheral edge of said tube insertion aperture is bent inwardly.

11. The header for use in heat exchangers as recited in claim

1 or 2, wherein said reinforcing wall has a side edge opposed to said base wall, and wherein said side edge is abutted against an inner surface of said base wall.

12. The header for use in heat exchangers as recited in claim 11, wherein said side edge of said reinforcing wall is integrally brazed to said base wall.

13. The header for use in heat exchangers as recited in claim 11 or 12, wherein said side edge of said reinforcing wall is abutted against said base wall continuously along a longitudinal direction of said header.

14. The header for use in heat exchangers as recited in claim 1 or 2, wherein a side edge portion of said reinforcing wall opposed to said base wall is bent outwardly to form a bent portion, and wherein said bent portion is secured to an inner surface of said base wall.

15. The header for use in heat exchangers as recited in claim 14, wherein said bent portion of said reinforcing wall is integrally brazed to said base wall.

16. The header for use in heat exchangers as recited in claim 14 or 15, wherein said bent portion of said reinforcing wall is

continuously formed along a longitudinal direction of said header.

17. The header for use in heat exchangers as recited in claim 14 or 15, wherein said bent portion of said reinforcing wall is intermittently formed at certain intervals along a longitudinal direction of said header.

18. The header for use in heat exchangers as recited in claim 17, wherein said side edge of said reinforcing wall between said bent portions adjacent in a longitudinal direction of said header is abutted against said base wall.

19. The header for use in heat exchangers as recited in claim 17, wherein said reinforcing wall has insertion ledges at said side edge of said reinforcing wall opposed to said base wall between said bent portions adjacent in a longitudinal direction of said header, wherein said base wall is provided with insertion ledge engaging apertures at positions corresponding to said insertion ledges, and wherein said insertion ledges are inserted into said insertion ledge engaging apertures and engaged therewith.

20. The header for use in heat exchangers as recited in claim 2, wherein one of said reinforcing walls is provided with insertion ledges at a side edge opposed to said base wall, wherein said base wall is provided with insertion ledge engaging apertures at

positions corresponding to said insertion ledges, wherein said insertion ledges are inserted into said insertion ledge engaging apertures and engaged therewith, and wherein a side edge of the other of said reinforcing walls opposed to said base wall is abutted against an inner surface of said base wall.

21. The header for use in heat exchangers as recited in claim 2, wherein one of said reinforcing walls is provided with insertion ledges at a side edge opposed to said base wall, wherein said base wall is provided with insertion ledge engaging apertures at positions corresponding to said insertion ledges, wherein said insertion ledges are inserted into said insertion ledge engaging apertures and engaged therewith, and wherein a side edge portion of the other of said reinforcing walls opposed to said base wall has an outwardly bent portion and said bent portion is secured to an inner surface of said base wall.

22. The header for use in heat exchangers as recited in claim 21, wherein said insertion ledges of said one of reinforcing walls are formed at certain intervals in a longitudinal direction of said header.

23. The header for use in heat exchangers as recited in claim 21, wherein said bent portions of said the other reinforcing wall are formed at certain intervals in a longitudinal direction of said

header.

24. The header for use in heat exchangers as recited in claim 2, wherein said one of said reinforcing walls is disposed such that a side edge of said one of said reinforcing walls opposed to said base wall is abutted against said base wall, and wherein said the other of said reinforcing walls is disposed such that a side edge portion of said the other of said reinforcing walls is bent outwardly to form a bent portion and said bent portion is secured to an inner surface of said base wall.

25. The header for use in heat exchangers as recited in claim 24, wherein said bent portion of said the other of said reinforcing walls is formed at certain intervals in a longitudinal direction of said header.

26. A header for use in heat exchangers, said header comprising:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall;

an opposite wall opposed to said base wall;

a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides; and

a reinforcing wall disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting said base wall to said opposite wall,

wherein said side walls are integrally formed at both lateral sides of said base wall by bending processing,

wherein a first half of said opposite wall constituting one half of said opposite wall is integrally formed at a side of one of said side walls by bending processing,

wherein a second half of said opposite wall constituting the other half of said opposite wall is integrally formed at a side of the other of said side walls by bending processing, and

wherein said reinforcing wall is integrally formed at respective sides of said first half of said opposite wall and said second half of said opposite wall by bending processing,

wherein insertion ledges are formed at certain intervals in a longitudinal direction of said header at side edges of said reinforcing walls opposed to said base wall,

wherein said insertion ledges of said one of said reinforcing walls and said insertion ledges of said the other of said reinforcing walls are disposed alternatively along said longitudinal direction of said header,

wherein said base wall is provided with insertion ledge engaging apertures at positions corresponding to said insertion ledges, and

wherein said insertion ledges are inserted into corresponding

insertion ledge engaging apertures and engaged therewith.

27. The header for use in heat exchangers as recited in claim 26, wherein said insertion ledge engaging apertures are formed along said longitudinal direction of said header in a zigzag manner.

28. The header for use in heat exchangers as recited in claim 26 or 27, wherein said tip portion of said insertion ledge is bent to form a bent portion with said insertion ledge inserted into said insertion ledge engaging aperture and said bent portion is engaged with an external surface of said base wall.

29. The header for use in heat exchangers as recited in claim 28, wherein said bent portion is formed by bending said tip portion of said insertion ledge by caulking processing.

30. A method for manufacturing a header for use in heat exchangers, said header including a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall, an opposite wall opposed to said base wall, a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides, and a reinforcing wall disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting said base wall with

said opposite wall, said method comprising:

a step for preparing a formed plate, said formed plate including a base wall region having said plurality of tube insertion apertures and extending in a longitudinal direction of said formed plate, a pair of side wall regions formed at both lateral sides of said base wall region and extending in said longitudinal direction, a first half region of an opposite wall formed at one of lateral sides of said base wall 1 region and extending in said longitudinal direction, a second half region of an opposite wall formed at the other of lateral sides of said base wall region and extending in said longitudinal direction, and a reinforcing wall region formed at at least one of said first half and second half regions of said opposite wall and extending in said longitudinal direction;

a step for bending said reinforcing wall region relative to said first half region of said opposite wall and/or said second half region of said opposite wall;

a step for bending said first half region of said opposite wall and/or said second half region of said opposite wall relative to said side wall regions; and

a step for bending said side wall regions relative to said base wall region, to thereby obtain said header in which said base wall, said side walls, said opposite wall and said reinforcing wall are constituted by said base wall region, said side wall regions, said opposite wall region and said reinforcing wall region,

respectively.

31. The method for manufacturing a header for use in heat exchangers as recited in claim 30, wherein, in said step for preparing said formed plate, said reinforcing wall region is formed at each side of said first half region and said second half region of said opposite wall.

32. The method for manufacturing a header for use in heat exchangers as recited in claim 30, wherein, in said step for preparing said formed plate, tube engaging cut-out portions are formed at portions of said reinforcing wall corresponding to said plurality of tube insertion apertures such that ends of said heat exchanging tubes inserted in said tube insertion apertures are engaged with said engaging cut-out portions in a positioned manner.

33. The method for manufacturing a header for use in heat exchangers as recited in any one of claims 30 to 32, wherein, in said step for preparing said formed plate, insertion ledges are formed at a base wall side edge of said reinforcing wall and insertion ledge engaging apertures are formed at positions of said base wall corresponding to said insertion ledges, further comprising a step of inserting said insertion ledges into said insertion ledge engaging apertures.

34. The method for manufacturing a header for use in heat exchangers as recited in any one of claims 30 to 33, wherein, in said step for preparing said formed plate, said formed plate is formed by die-cutting and pressing a brazing sheet with a brazing layer clad on at least one surface thereof.

35. The method for manufacturing a header for use in heat exchangers as recited in claim 34, further comprising a step of brazing an assembly obtained by said bending steps in a furnace.

36. A heat exchanger, comprising:

a pair of headers for use in heat exchangers; and

a plurality of heat exchanging tubes disposed in parallel with each other between said pair of headers with opposite ends thereof communicated with said headers,

wherein at least one of said pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting said heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall;

an opposite wall opposed to said base wall;

a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides; and

a reinforcing wall disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting

said base wall to said opposite wall,

wherein said side walls are integrally formed at both lateral sides of said base wall by bending processing,

wherein a first half of said opposite wall constituting one half of said opposite wall is integrally formed at a side of one of said side walls by bending processing,

wherein a second half of said opposite wall constituting the other half of said opposite wall is integrally formed at a side of the other of said side walls by bending processing, and

wherein said reinforcing wall is integrally formed at at least one of sides of said first half of said opposite wall and said second half of said opposite wall by bending processing.

37. The exchanger as recited in claim 36, wherein said reinforcing wall is provided with tube engaging cut-out portions formed at positions corresponding to said plurality of tube insertion apertures, whereby each end of said plurality of heat exchanging tubes inserted into said tube insertion apertures is engaged with said tube engaging cut-out portion in a positioned manner.

38. The exchanger as recited in claim 36 or 37, wherein said each end of said plurality of heat exchanging tubes is brazed to said header.

39. A heat exchanger, comprising:

a pair of headers for use in heat exchangers; and

a plurality of heat exchanging tubes disposed in parallel with each other between said pair of headers with opposite ends thereof communicated with said headers,

wherein at least one of said pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting said heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall;

an opposite wall opposed to said base wall;

a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides; and

reinforcing walls disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting said base wall to said opposite wall,

wherein said side walls are integrally formed at both lateral sides of said base wall by bending processing,

wherein a first half of said opposite wall constituting one half of said opposite wall is integrally formed at a side of one of said side walls by bending processing,

wherein a second half of said opposite wall constituting the other half of said opposite wall is integrally formed at a side of the other of said side walls by bending processing,

wherein each of said reinforcing walls is integrally formed

at each of sides of said first half of said opposite wall and said second half of said opposite wall by bending processing,

wherein each of said reinforcing walls is provided with insertion ledges at a base wall side edge of said reinforcing wall opposed to said base wall at predetermined intervals in a longitudinal direction of said header,

wherein said insertion ledges of one of said reinforcing walls and said insertion ledges of the other of said reinforcing walls are disposed alternatively in said longitudinal direction of said header,

wherein said base wall is provided with insertion ledge engaging apertures at positions corresponding to said insertion ledges, and

wherein said insertion ledges are inserted into said insertion ledge engaging apertures and engaged therewith, respectively.

40. The exchanger as recited in claim 39, wherein said reinforcing wall is provided with tube engaging cut-out portions formed at positions corresponding to said plurality of tube insertion apertures, whereby each end of said plurality of heat exchanging tubes inserted into said tube insertion apertures is engaged with said tube engaging cut-out portion in a positioned manner.

41. The exchanger as recited in claim 39 or 40, wherein said each end of said plurality of heat exchanging tubes is brazed to said header.

42. The exchanger as recited in any one of claims 39 to 41, wherein said insertion ledge engaging apertures are formed in a zigzag manner in said longitudinal direction of said header.

43. A manufacturing method of a heat exchanger, the method comprising:

a step for preparing a pair of headers for use in heat exchangers;

a step for preparing a plurality of heat exchanging tubes; and

a step for disposing said plurality of heat exchanging tubes in parallel with each other between said pair of headers with opposite ends thereof communicated with said headers,

wherein at least one of said pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall;

an opposite wall opposed to said base wall;

a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides; and

a reinforcing wall disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting said base wall to said opposite wall,

wherein said side walls are integrally formed at both lateral sides of said base wall by bending processing,

wherein a first half of said opposite wall constituting one half of said opposite wall is integrally formed at a side of one of said side walls by bending processing,

wherein a second half of said opposite wall constituting the other half of said opposite wall is integrally formed at a side of the other of said side walls by bending processing, and

wherein said reinforcing wall is integrally formed at at least one of sides of said first half of said opposite wall and said second half of said opposite wall by bending processing.

44. The manufacturing method of a heat exchanger method as recited in claim 43, wherein said step for preparing said header comprises:

a step for preparing a formed plate, said formed plate including a base wall region having said plurality of tube insertion apertures and extending in a longitudinal direction of said formed plate, a pair of side wall regions formed at both lateral sides of said base wall region and extending in said longitudinal direction, a first half region of an opposite wall formed at one of lateral sides of said base wall 1 region and extending in said

longitudinal direction, a second half region of an opposite wall formed at the other of lateral sides of said base wall region and extending in said longitudinal direction, and a reinforcing wall region formed at at least one of said first half and second half regions of said opposite wall and extending in said longitudinal direction;

a step for bending said reinforcing wall region relative to said first half region of said opposite wall and/or said second half region of said opposite wall;

a step for bending said first half region of said opposite wall and/or said second half region of said opposite wall relative to said side wall regions; and

a step for bending said side wall regions relative to said base wall region.

45. The manufacturing method of a heat exchanger as recited in claim 43 or 44, wherein said each end of said plurality of heat exchanging tubes is brazed to said header.

46. A manufacturing method of a heat exchanger, the method comprising:

a step for preparing a pair of headers for use in heat exchangers;

a step for preparing a plurality of heat exchanging tubes; and

a step for disposing said plurality of heat exchanging tubes in parallel with each other between said pair of headers with opposite ends thereof communicated with said headers,

wherein at least one of said pair of headers includes:

a base wall with a plurality of tube insertion apertures for inserting heat exchanging tubes formed at predetermined intervals in a longitudinal direction of said base wall;

an opposite wall opposed to said base wall;

a pair of side walls disposed at both lateral sides of said base wall and said opposite wall and connecting said lateral sides; and

reinforcing walls disposed between said base wall and said opposite wall along a longitudinal direction thereof and connecting said base wall to said opposite wall,

wherein said side walls are integrally formed at both lateral sides of said base wall by bending processing,

wherein a first half of said opposite wall constituting one half of said opposite wall is integrally formed at a side of one of said side walls by bending processing,

wherein a second half of said opposite wall constituting the other half of said opposite wall is integrally formed at a side of the other of said side walls by bending processing,

wherein each of said reinforcing walls is integrally formed at each of sides of said first half of said opposite wall and said second half of said opposite wall by bending processing,

wherein each of said reinforcing walls is provided with insertion ledges at a base wall side edge of said reinforcing wall opposed to said base wall at predetermined intervals in a longitudinal direction of said header,

wherein said insertion ledges of one of said reinforcing walls and said insertion ledges of the other of said reinforcing walls are disposed alternatively in said longitudinal direction of said header,

wherein said base wall is provided with insertion ledge engaging apertures at positions corresponding to said insertion ledges, and

wherein said insertion ledges are inserted into said insertion ledge engaging apertures and engaged therewith, respectively.

47. The manufacturing method of a heat exchanger method as recited in claim 46, wherein said step for preparing said header comprises:

a step for preparing a formed plate, said formed plate including a base wall region having said plurality of tube insertion apertures and extending in a longitudinal direction of said formed plate, a pair of side wall regions formed at both lateral sides of said base wall region and extending in said longitudinal direction, a first half region of an opposite wall formed at one of lateral sides of said base wall 1 region and extending in said

longitudinal direction, a second half region of an opposite wall formed at the other of lateral sides of said base wall region and extending in said longitudinal direction, and a reinforcing wall region formed at at least one of said first half and second half regions of said opposite wall and extending in said longitudinal direction;

a step for bending said reinforcing wall region relative to said first half region of said opposite wall and/or said second half region of said opposite wall;

a step for bending said first half region of said opposite wall and/or said second half region of said opposite wall relative to said side wall regions; and

a step for bending said side wall regions relative to said base wall region.

48. The manufacturing method of a heat exchanger as recited in claim 46 or 47, wherein said each end of said plurality of heat exchanging tubes is brazed to said header.

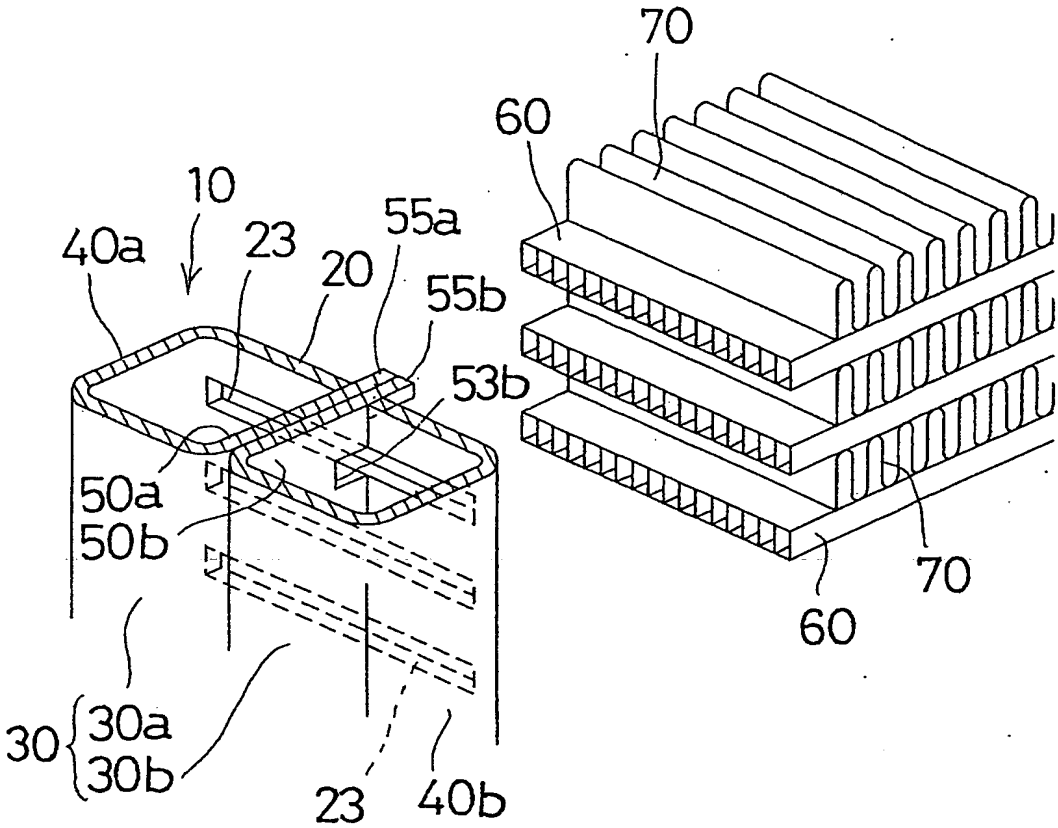


FIG.1

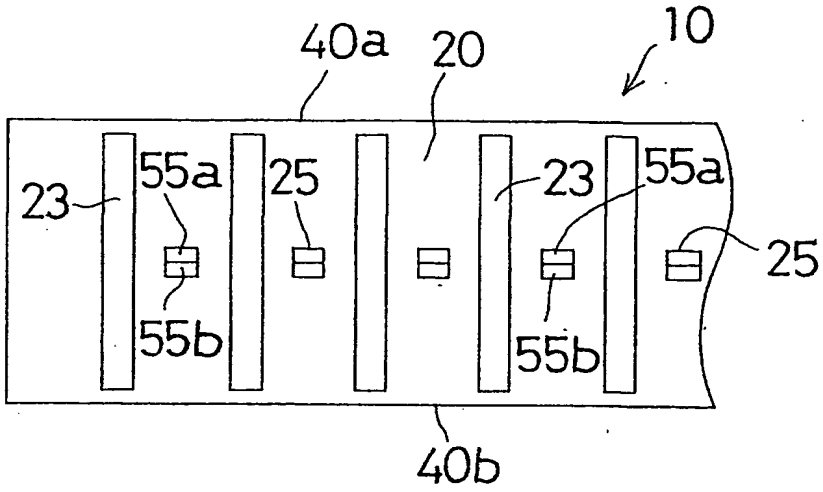


FIG.2A

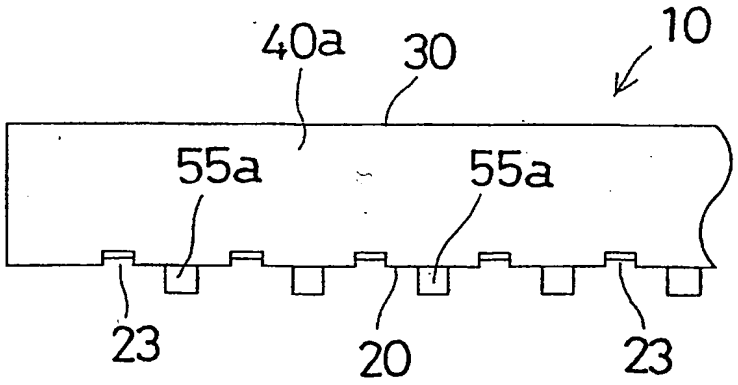


FIG.2B

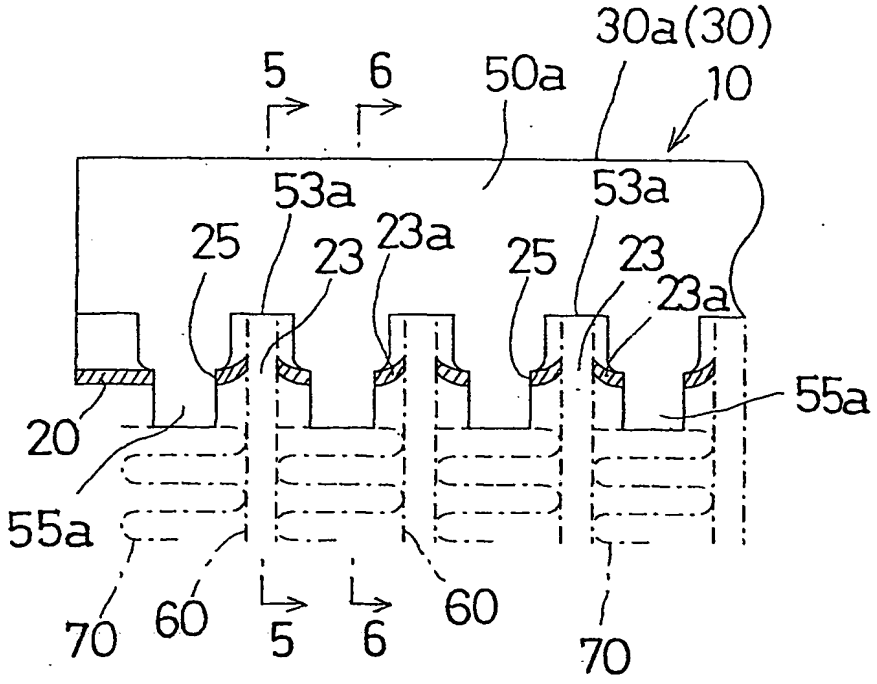

30a(30)
5
6
50a
10
53a
53a
25
23
23a
25
23
23a
55a
20
55a
70
60
5
6
60
70

FIG.3

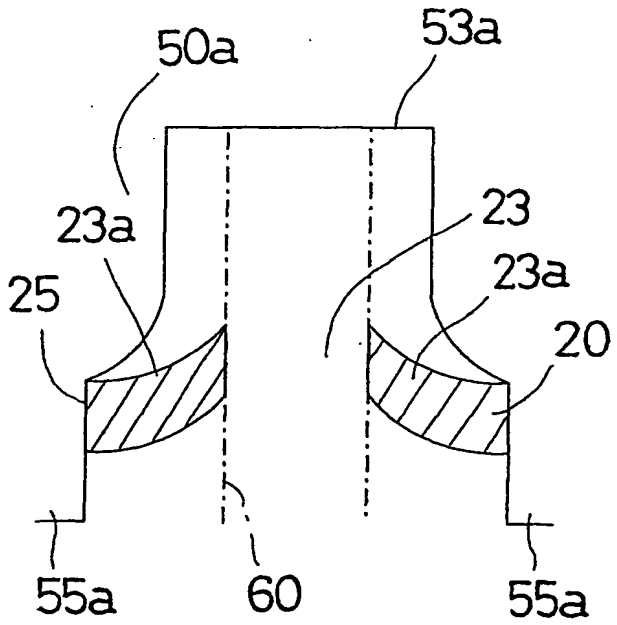

50a
53a
23a
23
25
23a
20
55a
60
55a

FIG.4

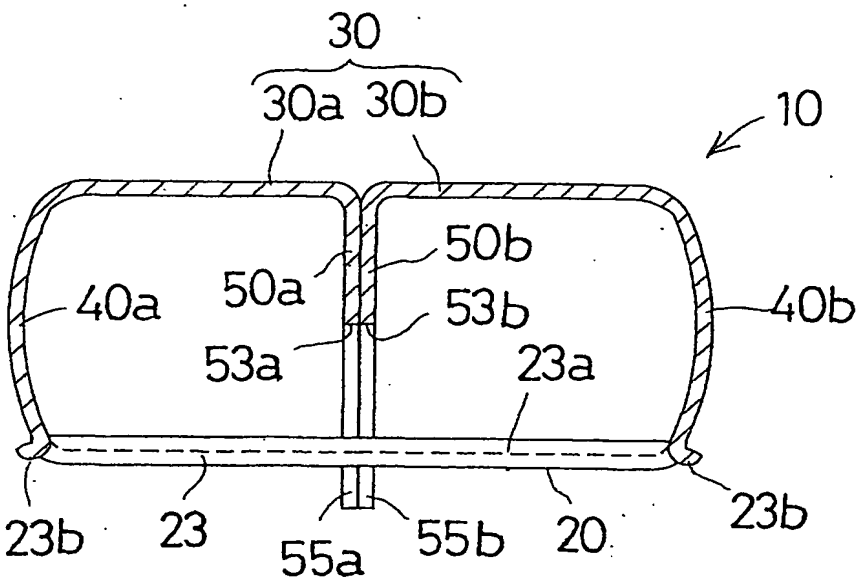


FIG.5

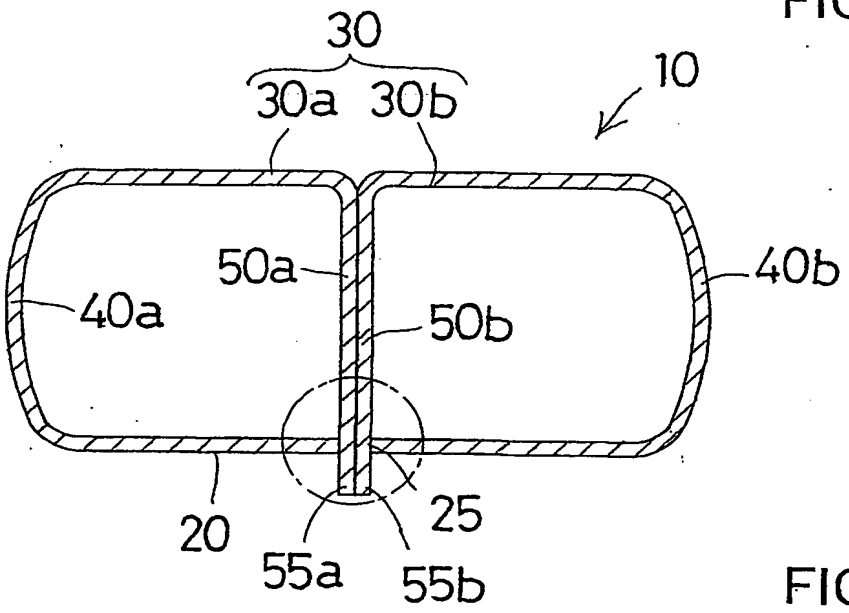


FIG.6A

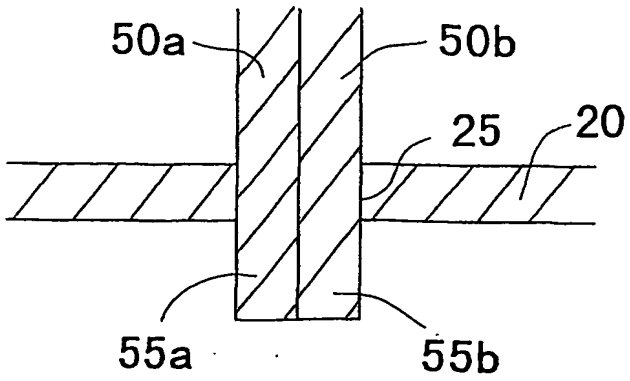


FIG.6B

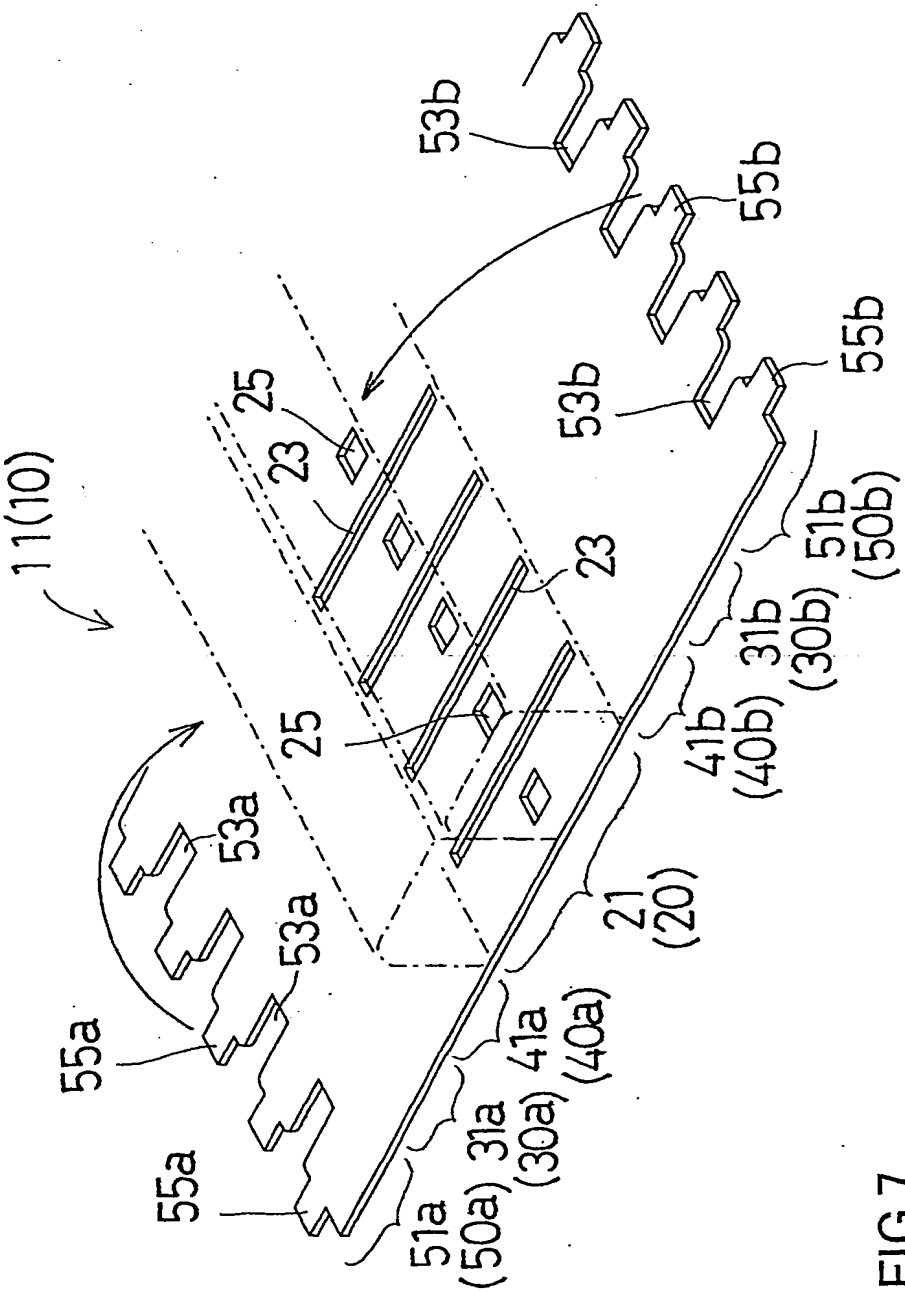

11(10)
25
23
53b
55b
53b
55b
23
51b
(50b)
31b
(30b)
41b
(40b)
25
53a
53a
21
(20)
55a
41a
(40a)
55a
31a
(30a)
51a
(50a)

FIG.7

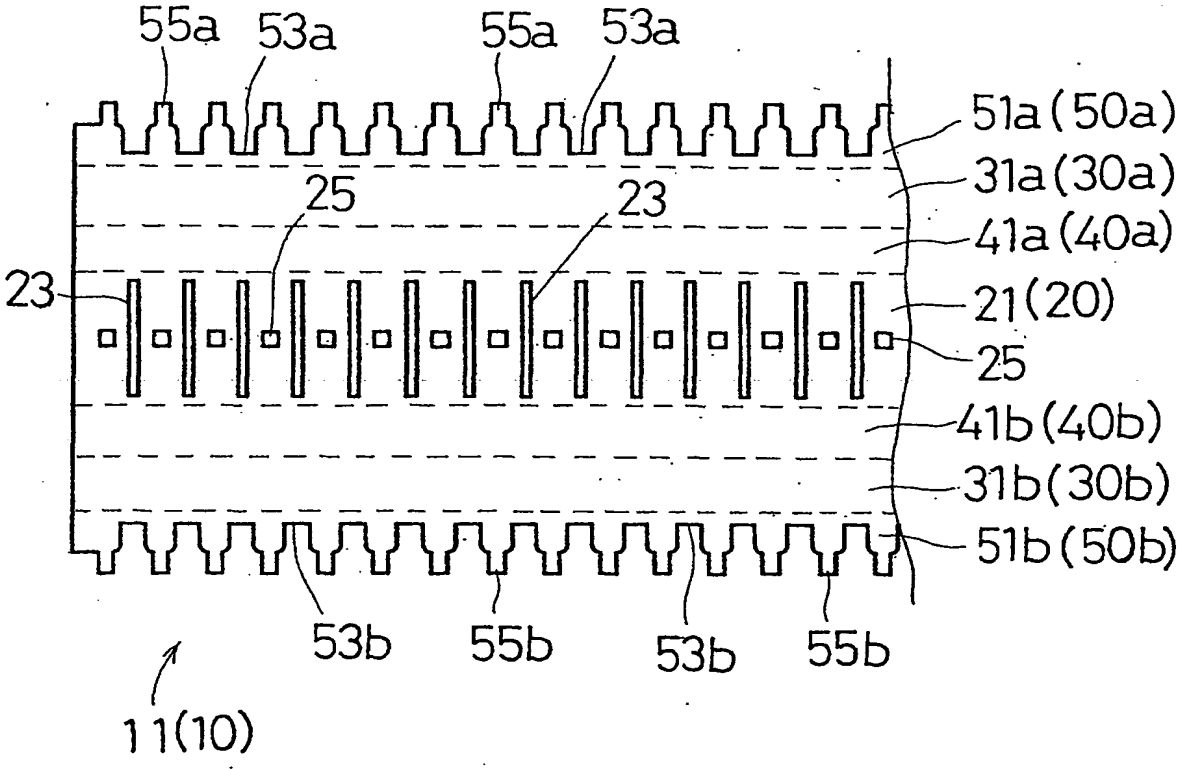

55a
53a
55a
53a
51a(50a)
31a(30a)
25
23
41a(40a)
23
21(20)
25
41b(40b)
31b(30b)
51b(50b)
53b
55b
53b
55b
11(10)

FIG.8

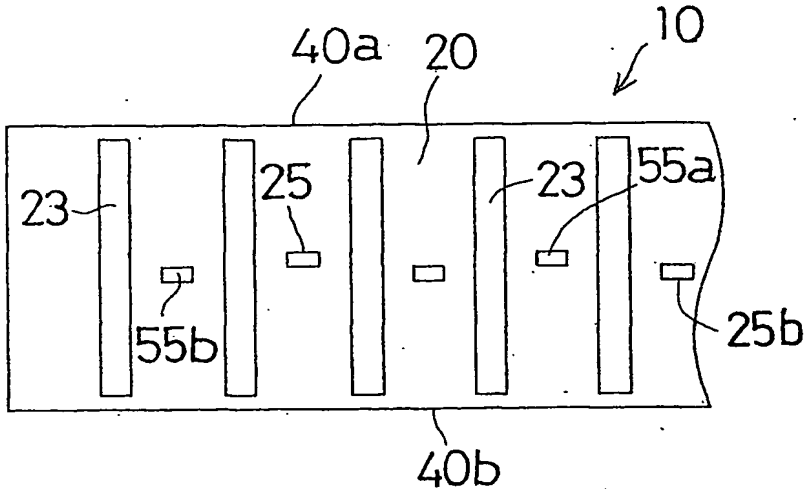

40a
20
10
23
25
23
55a
55b
25b
40b

FIG.9

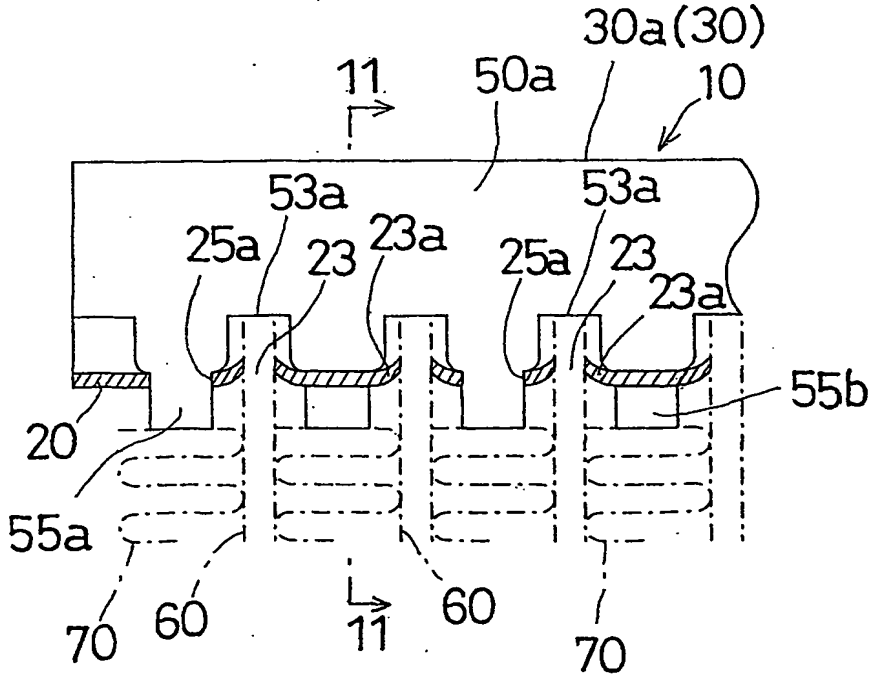

30a(30)
11
50a
10
53a
53a
25a
23
23a
25a
23
23a
55b
20
55a
70
60
11
60
70

FIG.10

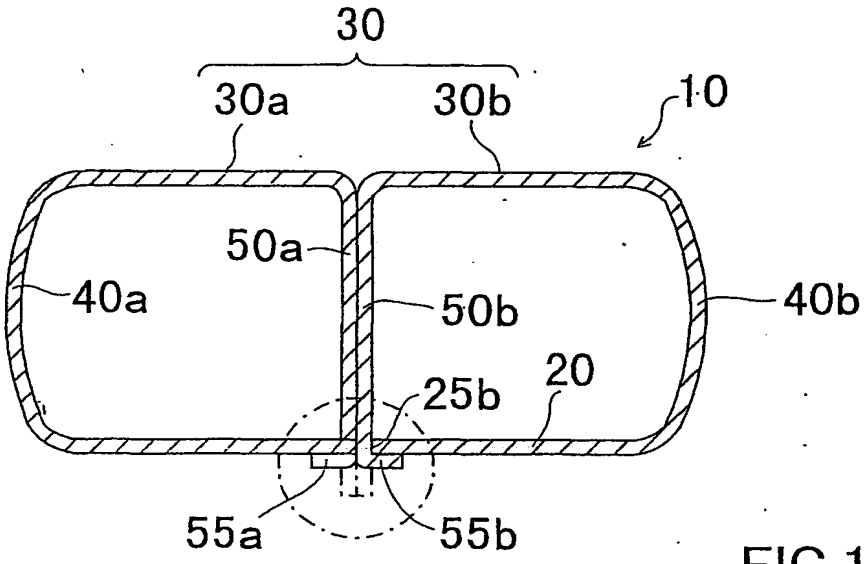


FIG.11A

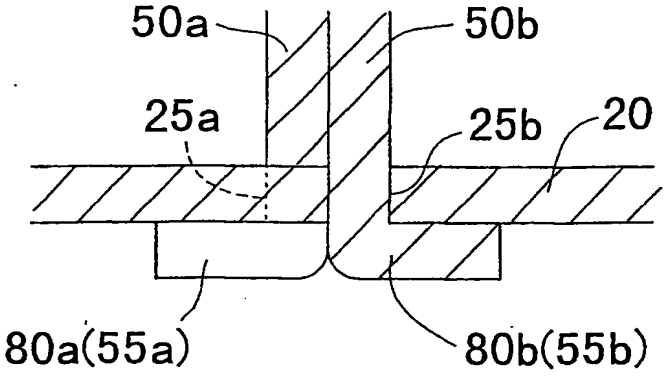
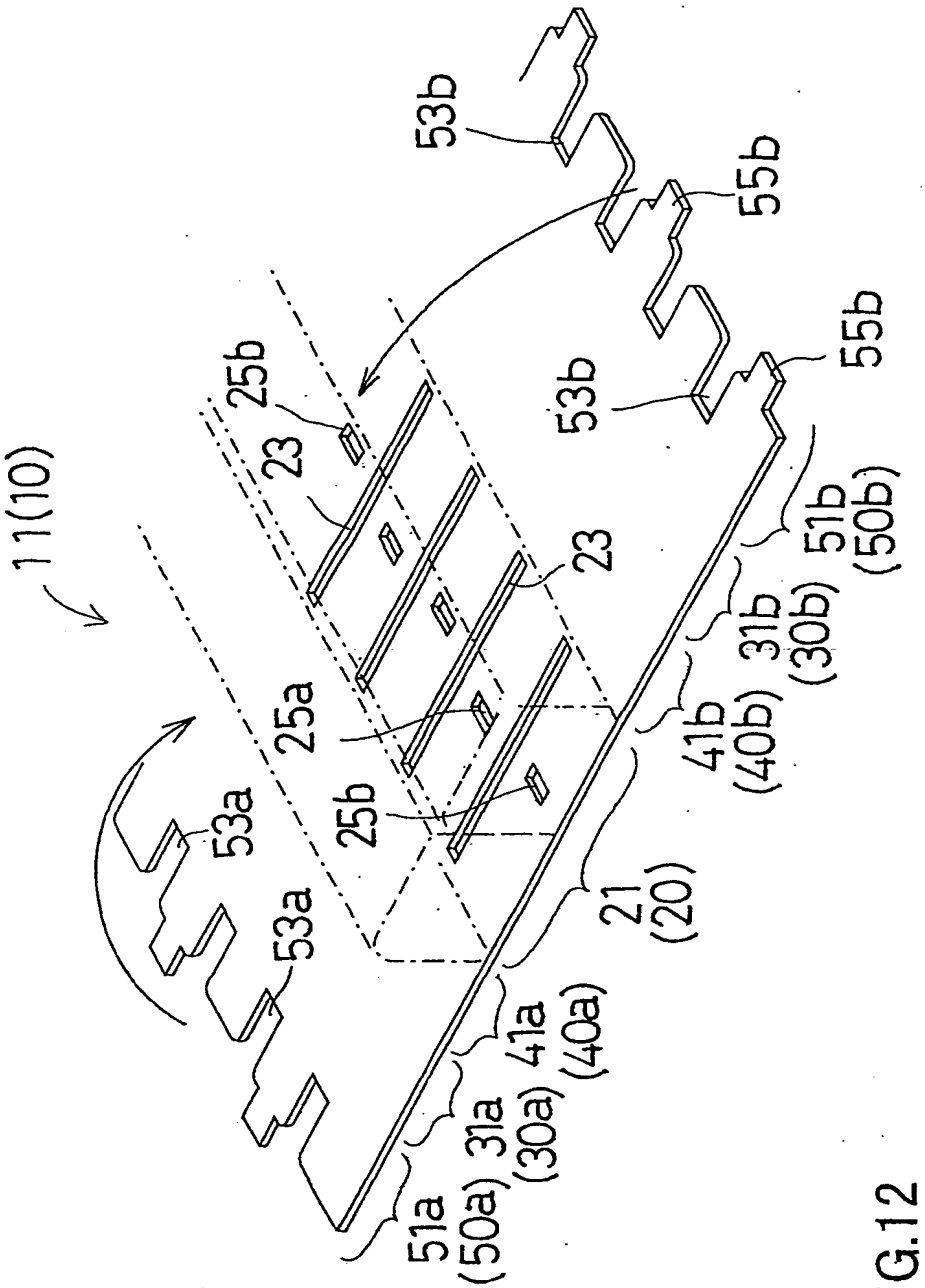


FIG.11B


11(10)
53b
55b
53b
55b
25b
23
23
51b
(50b)
31b
(30b)
41b
(40b)
25a
25b
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53a
21
(20)
41a
(40a)
31a
(30a)
51a
(50a)

FIG.12

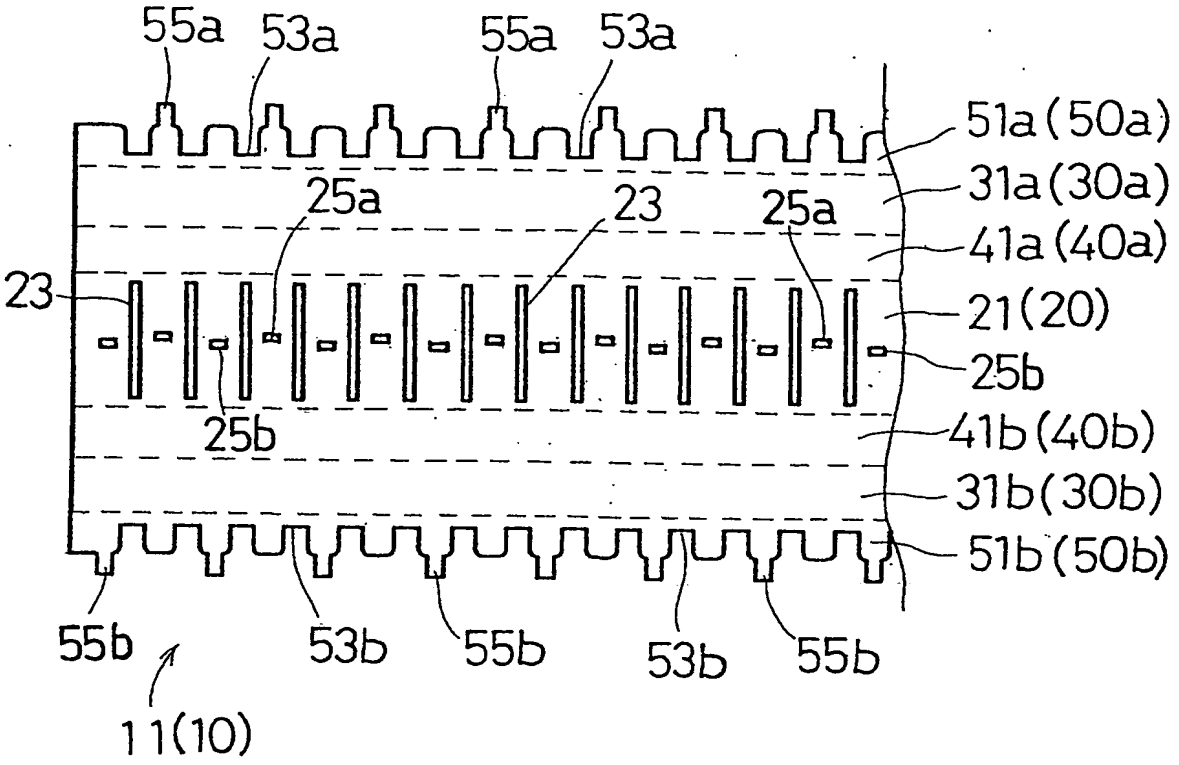
55a
53a
55a
53a
51a(50a)
31a(30a)
25a
23
25a
41a(40a)
23
21(20)
25b
25b
41b(40b)
31b(30b)
51b(50b)
55b
53b
55b
53b
55b
11(10)

FIG.13

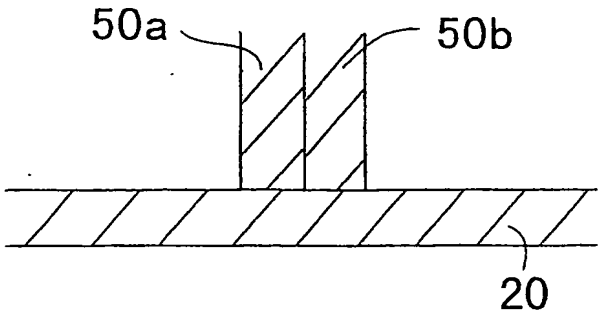

FIG.14A

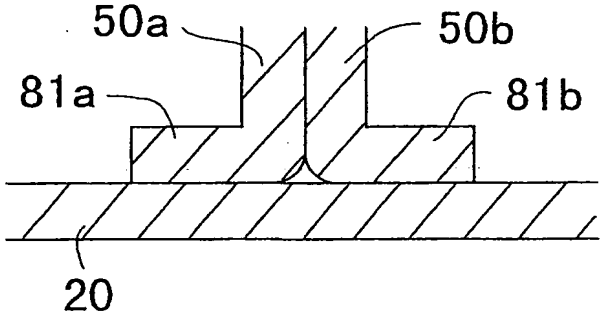

FIG.14B

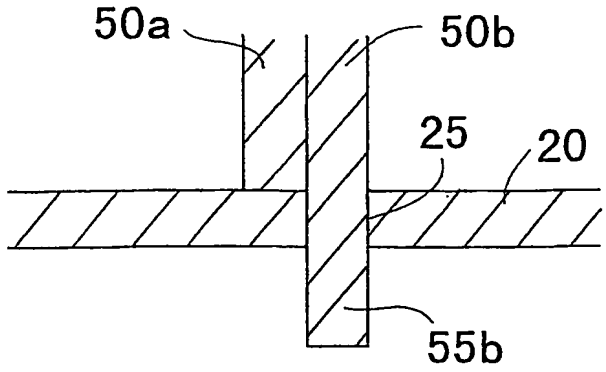

FIG.14C

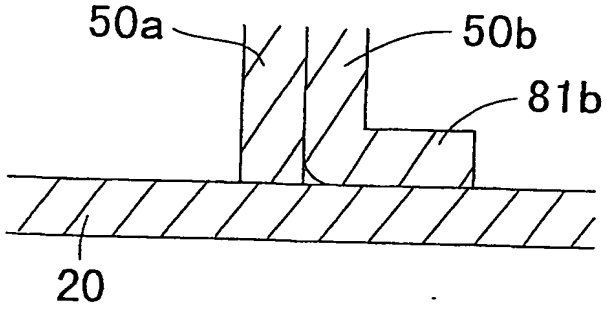

FIG.14D

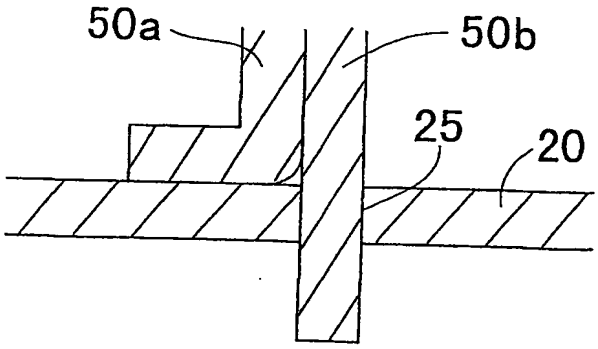

FIG.14E

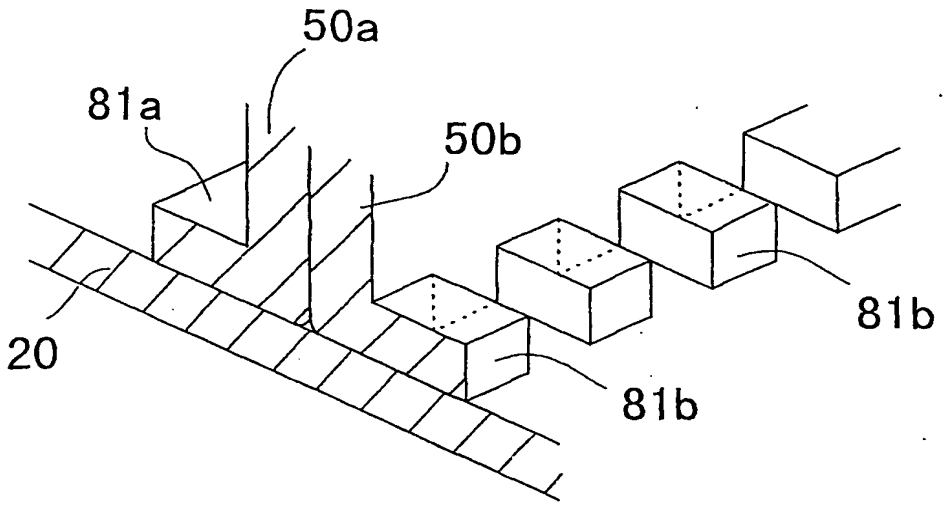

FIG.15A

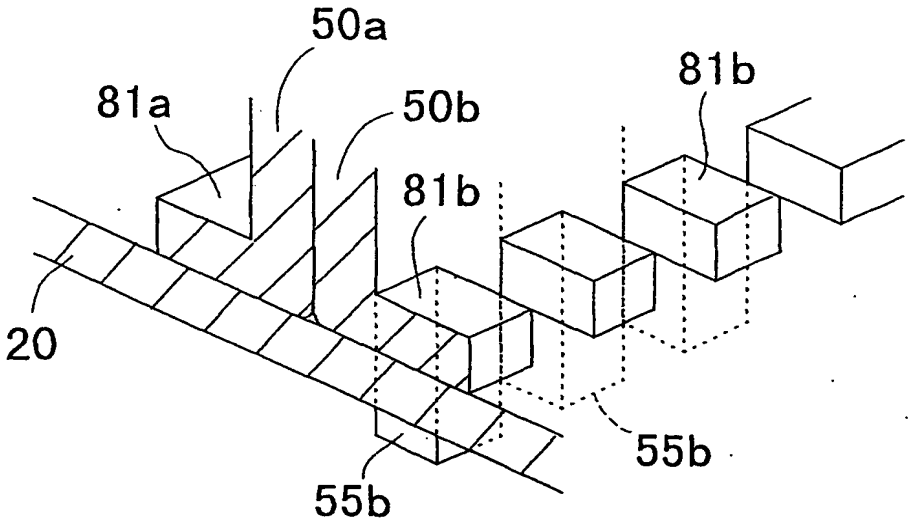

FIG.15B

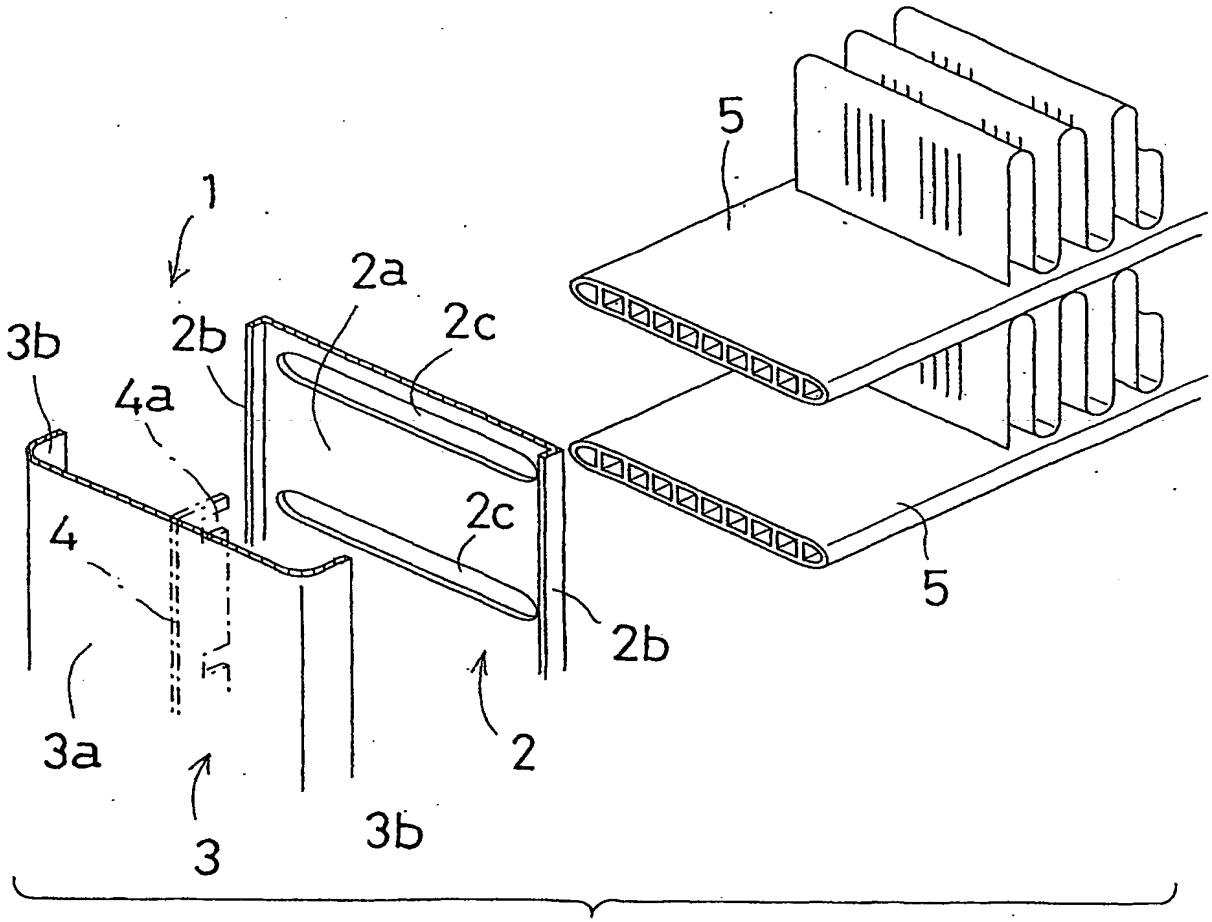

FIG.16